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GEIGER COUNTER
MODEL E-130A

DOCUMENT NUMBER ,TD E070.0410

RECORD OF REVISIONS

TITLE OF DOCUMENT

GEIGER COUNTER
MODEL E-130A

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TD E070.0410

Technical Manual for Geiger Counter Model E-130A

eberline

eberline service centers

July 1, 1980

Certified Calibration and Repair

Eberline Instrument Certified Calibration	Call Service Center for prices.
Other Manufacturer Instrument Certified Calibration	$100.00 each
Repair Rate Above Calibration plus Parts at List Price	$60.00/hr.

Contractual rates are available on periodic repair and/or calibration. Contact Service Center for prices.

Three (3) Year Extended Warranty:

This includes Certified Calibration plus Parts

1. Eberline Instruments, FOB Eberline Customer Service Facility . . . $70.00 each/quarter

Miscellaneous:

1. Turn Around Time:

   Calibration — Five (5) working days on Eberline instruments

   Repair — Twelve (12) working days on Eberline instruments, unless parts have to be ordered.

2. FOB Santa Fe, New Mexico or West Columbia, South Carolina

3. Instruments for warranty repair, repair, or calibration must be sent to:

Mr. Henry Gomez
Customer Service
Eberline Instrument Corporation
P.O. Box 2108, Airport Road
Santa Fe, New Mexico 87501
Telephone: 505/471-3232

Mr. John Witzell
Customer Service
Eberline Instrument Corporation
312 Miami Street
West Columbia, South Carolina 29169
Telephone: 803/796-3604

4. In addition, the following Customer Service Centers are available for customers outside the United States.

Eberline Instrument Co., Ltd.
Church Street
Dorking Surrey
England, RH41DQ
Telephone: 44-306-87836

Saskatchewan Research Council
Attn.: Mr. Don Barnett
30 Campus Drive
Saskatoon, Saskatchewan
Canada, S7N 0X1
Telephone: 306/664-5433

Prices at these locations will vary from U.S. prices. Please contact the facilities for current price and delivery information.

EBERLINE INSTRUMENTS STANDARD WARRANTY

One Year Warranty: Seller warrants to replace or repair, at its option, any products or parts thereof (excluding tubes, crystals and batteries [tubes and crystals 90 days]) which are found defective in material or workmanship within one year from date of shipment. Seller's obligation with regard to such products or parts shall be limited to replacement or repair, FOB seller's factory or authorized repair station, at seller's option. The aforesaid warranty does not cover normal life-end failure of components and will be voided if repair has been attempted by other than seller's authorized personnel. In no event shall seller be liable for consequential or special damages, transportation, installation, adjustment, work done by customer or other expenses which may arise in connection with such defective product or parts.

Exclusion of Warranties and Limitation of Liability: **The foregoing warranty is expressly made in lieu of any and all other warranties express or implied including the warranties of merchantability and fitness for a particular purpose. Under no circumstances shall seller be liable for any indirect, special, incidental or consequential damages to customer or to any third party.**

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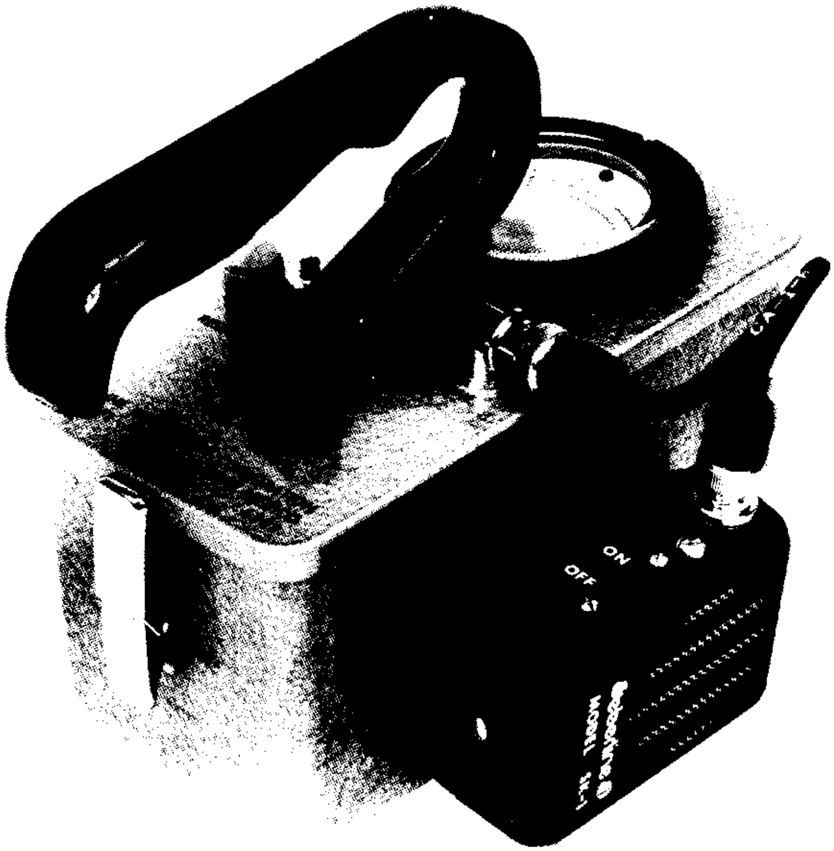


Figure 1-1. Model E-130A shown with SK-1 Speaker

SECTION I

GENERAL

A. PURPOSE AND DESCRIPTION

The Model E-130A is a small, lightweight geiger counter designed for the detection and measurement of gamma radiation.

The instrument is powered by two D-cell batteries, and special circuitry has been incorporated to conserve battery life; battery condition may be checked by a front panel control.

Measured radiation intensity appears on a large, easily read meter with a linear scale. Three switch-selected ranges give full scale sensitivities of 10, 100 and 1000 mR/h. The response time of the meter is continuously adjustable, and the reading may be brought to zero at any time by the reset control.

A phone output is provided for the use of earphones, an Eberline Model SK-1 Speaker, or for counting events with a scaler.

B. SPECIFICATIONS

1. DETECTOR

a. G-M Tube: Halogen quenched, energy compensated.

b. Sensitivity (^{137}Cs): Approximately 80 counts per minute (cpm) per mR/h.

c. Energy Response: See Figure 1-2.

d. Dead Time: Approximately 20 μseconds.

2. INDICATOR

a. Visual

(1) Scale Length: 1.76 inches (4.5 cm).

(2) Scale Marking: 0 to 10 mR/h with 20 increments. BATTery OK segment.

(3) Range: Switch controlled multipliers of X1, X10 and X100, yielding 10, 100 or 1000 mR/h.

(4) Response Time: Continuously adjustable by RESPONSE control from 2 seconds to 10 seconds, measured to 90% of final reading.

(5) Linearity: Within ±5% of full scale, typically ±2% of full scale.

(6) Saturation: Meter will remain pegged in ^{137}Cs fields greater than 1000 R/h.

(7) Battery Dependence: Calibration shifts less than 10% with battery voltage change from 3V to 2V (new batteries to end point).

b. AURAL

(1) Connector: BNC

(2) Signal: One pulse for each event counted. Negative 2.5V (nominal), capacitively coupled.

3. POWER

a. Battery Complement: 2 each D-cell batteries of any type with voltage between 1.0V and 1.6V per battery.

b. Battery Life: Dependent on battery type, age and temperature. Anticipated life with new batteries at room temperature is:

TYPE	LIFE
C-Zn	300 hours
Alkaline	500 hours
Mercury	700 hours
NiCd (single charge)	200 hours

4. ENVIRONMENTAL

a. Temperature: The instrument is operational from -40°F to +140°F (-40°C to 60°C) with a typical temperature coefficient of -0.15% per °F (-0.27% per °C). Maximum temperature coefficient -0.25% per °F (-0.45% per °C).

The type of battery used limits the low temperature performance as a result of a decrease in terminal voltage and an increase in internal impedance. For prolonged operation at low temperatures the following criteria are suggested:

BATTERY TYPE	USABLE TO
Mercury	+32°F (0°C)
CZn	0°F (-18°C)
Alkaline	-40°F (-40°C)
NiCd	-40°F (-40°C)

5. MECHANICAL

a. Size:

Height: 5-1/2 inches (14 cm), including handle.

Length: 6-3/4 inches (17.1 cm).

Width: 3-3/8 inches (8.6 cm).

b. Weight: With C-Zn batteries, 3 pounds (1.36 kg).

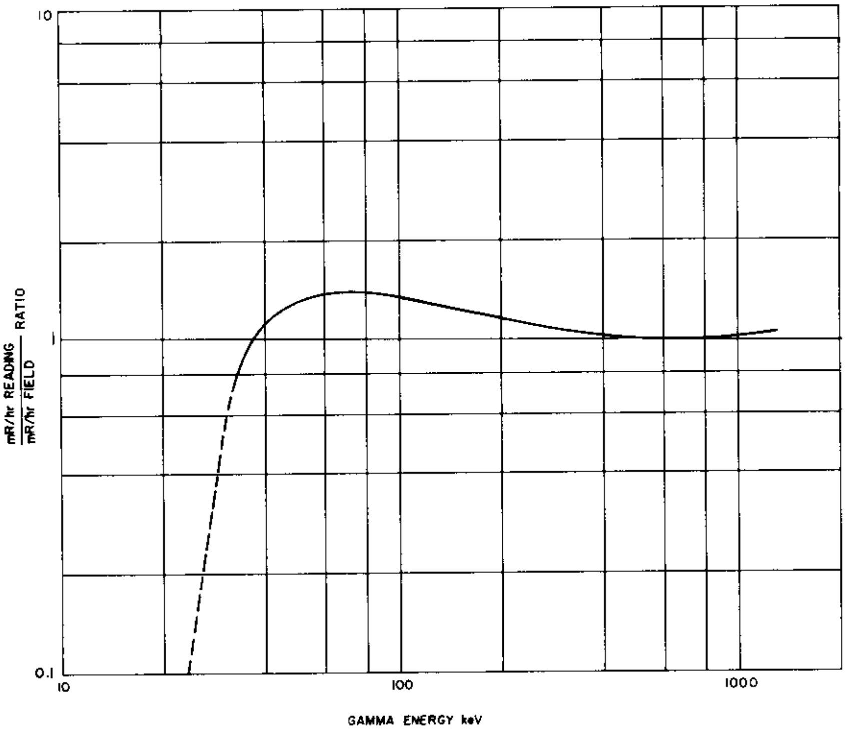


Figure 1-2. Typical Energy Response of E-130A

SECTION II

OPERATION

A. DESCRIPTION OF CONTROLS AND CONNECTORS

1. External (See Figure 2-1)

a. Switch: Five-position rotary switch that turns instrument OFF, checks BATTery condition and selects scale multipliers of 1, 10 or 100. This number must be multiplied by the meter reading to obtain the proper field intensity.

b. RESPONSE: Controls response time of meter to the most desirable compromise between speed and fluctuation for the particular usage.

c. RESET: Discharges integrating capacitor, bringing meter reading to zero rapidly.

d. PHONE: Pulse output for use with earphone, speaker or external scaler. Mating connector is BNC UG-88/U or equal.

2. Internal (See Figure 2-1)

a. Calibration Controls: One control for each range which individually calibrates that range to agree with the radiation field.

B. PREPARATION FOR USE

1. Inspection: The instrument should be checked for physical damage.

2. Operation Check: Place a check source in a repeatable position adjacent to the detector and move the switch to a range that gives an upscale reading. Note that the reading is sensitive to the position of the source. The reading may be recorded for future reference.

C. USING THE INSTRUMENT

1. Starting: Turn the switch to the BATTery check position. The meter should indicate within the BATT OK area.

2. Push the RESET button and the reading should drop to zero rapidly, then climb back to source reading when the RESET is released. The RESPONSE may be adjusted to get the most desirable compromise between speed of response and meter fluctuation.

3. Interpretation of Indications: The meter reading must be multiplied by the scale factor to obtain the proper number. The fluctuation of the meter is normal and is caused by the random nature of radioactive decay.

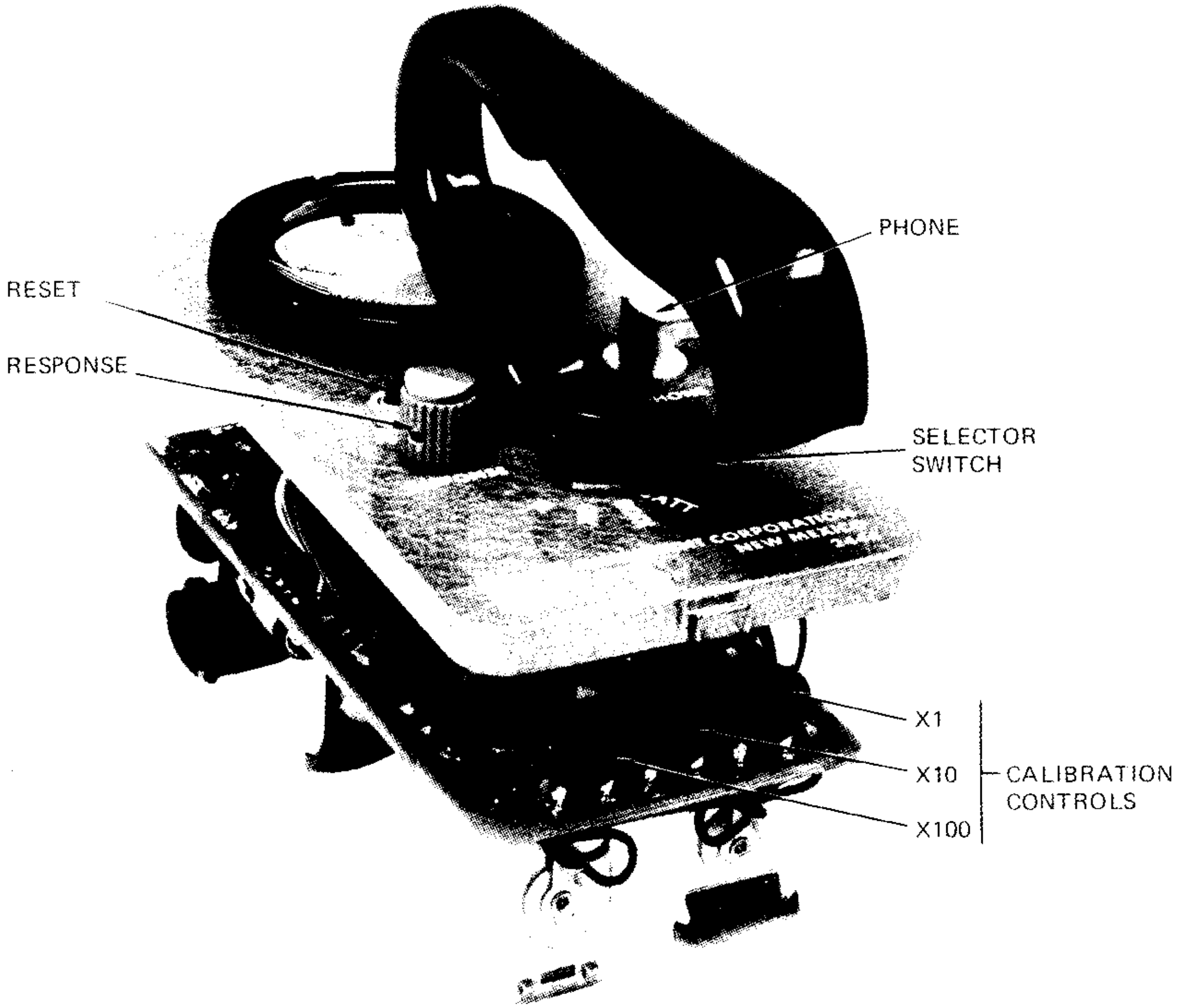


Figure 2-1. Internal and External Controls

SECTION III

THEORY OF OPERATION

A. GENERAL (See Figure 3-1)

The high voltage supply develops +500V, which is applied to the G-M tube, giving it the proper operating voltage. When radiation reacts in the G-M tube, negative pulses are generated. These pulses are amplified, then coupled to the trigger circuit where they are converted to standard size pulses of power. These standard pulses are applied to the meter driver which converts them to standard pulses of current, averages this current and drives the meter. Thus the meter deflection is proportional to the average of rate of radiation defected by the G-M tube.

B. FUNCTIONAL THEORY (See Figures 3-1 and 6-1)

1. High Voltage Supply: The oscillator transistor (Q1) drives T1 primary and gets its feedback from T1's red-orange winding. The voltage is stepped up by T1's secondary, rectified, filtered and applied to V1. V1 regulates at 500V. The current through V1 is sensed by Q2, amplified, and used to control the current through Q3. The current through Q3 controls the bias level of the oscillator Q1. This tends to hold the current through V1 to a constant value regardless of battery voltage. The result of this is that power is not wasted with new batteries, just so it will function with lower voltage batteries. This greatly extends battery life.

2. Amplifier: Q4 amplifies and inverts the negative input pulses from the detector. It is biased just into cutoff so its output is near 0V. A pulse turns it on and the resulting positive output pulse starts the trigger circuit.

3. Trigger: Integrated circuit A1 is connected to operate as a monostable multivibrator whose pulse width is controlled by the RC time constant between pins 7 and 3. This time constant is established by the setting of S1B (scale selection) which selects a particular R and C. The calibration controls form the R for each scale, making the pulse width continuously adjustable for calibration.

When the trigger is initiated by the pulse from Q4, the output at pin 6 goes positive and holds until the predetermined time (RC) elapses.

4. Meter Driver: The driver Q5 is normally off so no current flows through M1. When the trigger is on, Q5 is turned on and current flows. The amount of current is determined by the voltage on the base of Q5 and R15. The length of time that current flows is determined by the pulse width of the trigger. This (current times time) forms a certain charge which is transferred to C9 for each event counted. C9 discharges through M1, yielding a certain average current dependent on the rate of input pulses. Changing the pulse width of the trigger (i.e. changing scales or calibration pot setting) changes the average current for a given input pulse rate. This allows the meter to be calibrated to read in mR/hr (or cpm) at the detector.

The response time of M1 is controlled by the RC time constant of C9 and R16, the response control. With R16 set to low resistance the time constant is fast, and at high resistance it is slow.

5. Phone Driver: Q6 amplifies and inverts the output pulse from the trigger, yielding a large amplitude, negative going pulse which is capacitively coupled to the PHONE connector.

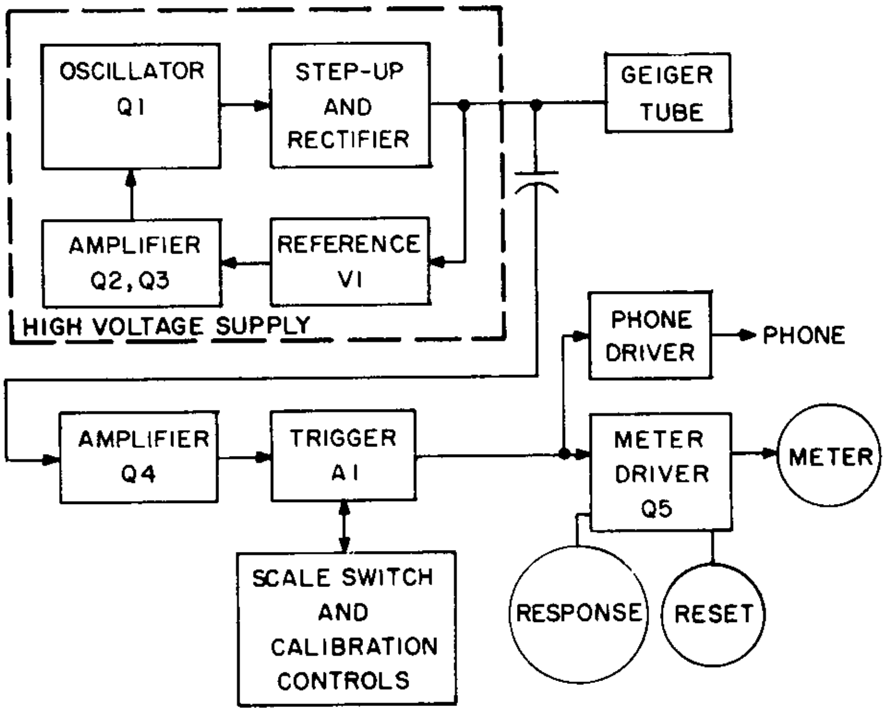


Figure 3-1. System Block Diagram

SECTION IV

MAINTENANCE

A. DISASSEMBLY AND REASSEMBLY

1. Batteries: The batteries are secured in captive holders on the etched board. The holding straps may be removed by hand, but a small screwdriver facilitates their removal. Pull the batteries from the holders. Replace by sliding batteries into holders, making certain they are centered and of the correct polarity. Replace holding straps.

2. Etched Board: The electrical board and cover may be separated for troubleshooting. Proceed as follows:

   a. Remove the batteries to prevent electrical damage during disassembly.

   b. Remove the knob and mounting nut from the scale switch.

   c. Remove the two nuts from the meter studs.

   d. Separate the board and cover without putting undue stress on wires.

   e. For troubleshooting connect jumpers from the meter studs to corresponding points on the board and replace the batteries.

   f. Reassemble in reverse order of disassembly.

B. PREVENTIVE MAINTENANCE

1. Keep the instrument clean and dry.

2. Replace batteries when their check reading is below the acceptable level.

3. Remove batteries if the instrument is to be inactive for a long period.

C. CALIBRATION

For maximum accuracy, the instrument should be calibrated under the same conditions as it will be used. Refer to Section I.B. for effects of gamma energy, battery voltage and temperature. Proceed as follows:

1. Each range is individually calibrated by a calibration control. Repeat the procedure below for each range:

   a. Position the instrument on a calibration range so the detector center is in a field corresponding to near 3/4 scale meter reading.

   b. Expose the gamma source and note the instrument reading. Adjust the calibration control for the range selected until the meter indication agrees with the field.

D. TROUBLESHOOTING

Typical voltages and waveforms are given on the schematic (Figure 6-1) and component locations are shown in Figure 6-2.

Voltages are measured with a 20,000 Ω per V, or greater, voltmeter except the 500V point. An electrostatic voltmeter should be used to check the 500V; however, if one is not available, a conventional meter may be used if loading is accounted for.

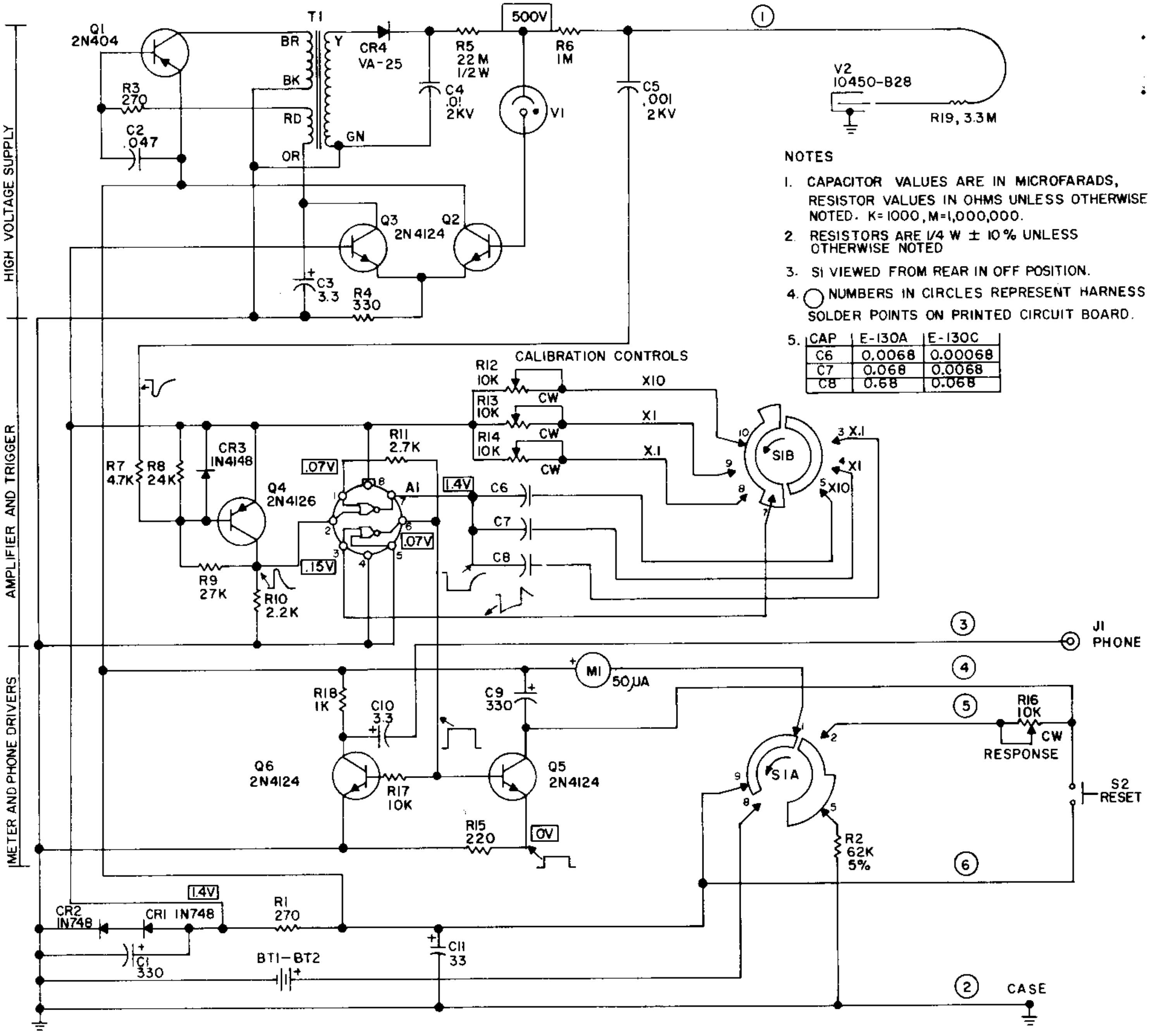
SECTION V

PARTS LIST

REF DESIG	PART	DESCRIPTION	MFR AND PART NO
A1	Integrated Circuit	RTL Dual NOR Gate	Motorola MC910G or equal
BT1, BT2	Battery	C-Zn D-cell	Eveready 1050 or equivalent
	Battery holder		Cambion 2895-2
C2	Capacitor	0.047 ± 20%µF, 50V	G.E. 75F145A473
C3, C10	Capacitor	3.3 ± 20%µF, 10V	Kemet K3R3C10 or equivalent
C4	Capacitor	0.01µF, 2 kV	Sprague BL-S10
C5	Capacitor	0.001µF, 2 kV	Sprague BL-D10
C6	Capacitor	0.0068 ± 10% µF, 400V	G.E. 75F1R4A682
C7	Capacitor	0.068 ± 10%, µF, 50V	G.E. 75F2R5A683
C8	Capacitor	0.68 ± 10% µF, 50V	G.E. 75F6R5A684
C9, C1	Capacitor	330 ± 20%µF, 6V	Kemet K330C6 or equivalent
C11	Capacitor	33 ± 20%µF, 10V	
CR1, CR2	Diode		1N748
CR3	Diode		1N4148
CR4	Diode	2500 PIV	Varo VA-25 or equivalent
J1	Phone Jack		UG-1098/U
M1	Meter	0-50µA	Triplett 221HR
Q1	Transistor	PNP Ge	2N404
Q2, Q3, Q5, Q6	Transistor	NPN Si	Motorola 2N4124
Q4	Transistor	PNP Si	Motorola 2N4126
R1, R3	Resistor	270 ± 10%, 1/4W	
R2	Resistor	62k, ± 5%, 1/4W	
R4	Resistor	330 ± 10%, 1/4W	
R5	Resistor	22 MΩ, ± 10%, 1/2W	
R6	Resistor	1 MΩ, ± 10%, 1/4W	
R7	Resistor	4.7k, ± 10%, 1/4W	
R8	Resistor	24k, ± 5%, 1/4W	
R9	Resistor	27k, ± 10%, 1/4W	
R10	Resistor	2.2k, ± 10%, 1/4W	
R11	Resistor	2.7k, ± 10%, 1/4W	
R12, R13, R14	Potentiometer	10k	CTS (Type XHT201R103B) #RR9167
R15	Resistor	220 ± 10%, 1/4W	
R16	Potentiometer	RV6 Style, 10k ± 20%, linear taper	CTS Series 300 or equivalent CTS 42444
R17	Resistor	10k ± 10%, 1/4W	
R18	Resistor	1k ± 10%, 1/4W	
R19	Resistor	3.3M ± 10%, 1/4W	

REF DESIG	PART	DESCRIPTION	MFR AND PART NO
S1	Switch	Scale	EIC 10434-B14
S2	Switch	RESET	Grayhill 30-1
T1	Transformer		Microtran M-8050
V1	Regulator Tube	500V ± 2%	Victoreen GV3B-500
V2	G-M Tube		EIC 10450-B28

SECTION VI
DIAGRAMS

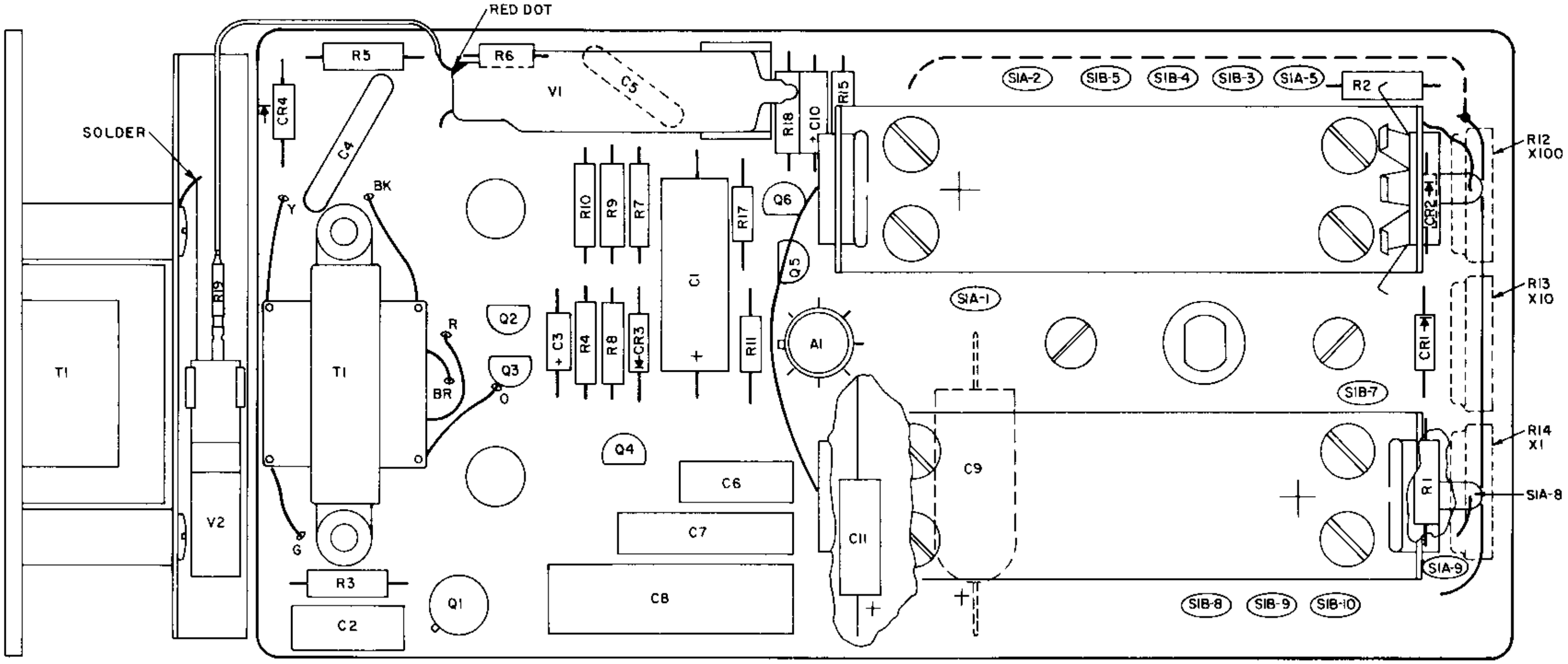


NOTES

1. CAPACITOR VALUES ARE IN MICROFARADS, RESISTOR VALUES IN OHMS UNLESS OTHERWISE NOTED. K=1000, M=1,000,000.
2. RESISTORS ARE 1/4 W ± 10% UNLESS OTHERWISE NOTED
3. S1 VIEWED FROM REAR IN OFF POSITION.
4. ◯ NUMBERS IN CIRCLES REPRESENT HARNESS SOLDER POINTS ON PRINTED CIRCUIT BOARD.
5.

CAP	E-130A	E-130C
C6	0.0068	0.00068
C7	0.068	0.0068
C8	0.68	0.068

Figure 6-1. General Schematic



NOTE:
○ CODE IN OVALS SIGNIFIES JUMPER TO CORRESPONDING POINT ON SWITCH S1. (ON BACK SIDE)

Figure 6-2. Component Layout